BELLCOMM, INC.

SUBJECT: A Status Review of ACE Carry-off Cooling and Purging - Case 330

DATE: April 22, 1966

FROM: L. G. Miller

ABSTRACT

This memorandum presents the recent history and present status of efforts to provide cooling and purging gas for ACE carry-off equipment. The MSC requirements, by facility, are presented, and the KSC approach for implementing these requirements is indicated.

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MEMORANDUM FOR FILE

Introduction

This memorandum presents the recent history and present status of efforts to provide cooling and purging gas for ACE carry-off equipment. The equipment under discussion was formerly located in the spacecraft during prelaunch checkout. It is now to be located on the service structure on LC 34 and 37 and on the MSS on LC 39.

Recent Developments

On March 22-23, a LEM mock-up countdown demonstration took place at North American Aviation.(1) The question of purging and/or cooling of the ACE carry-off equipment was brought up while evaluating the demonstration with respect to launch systems. At that time, no firm decision had been made as to the locations of the LEM and CSM ACE carry-off equipment. There were also unresolved questions regarding environmental protection, the need for purging, and the amount of heat generated by the ACE carry-off.

It was subsequently learned that an action item(2) was placed on MSC/PD4 to determine minimum MSC requirements for purging and cooling ACE carry-off equipment for AS 202.

On April 5-7, the writer attended a MSC/MILA interface definition meeting during which detailed discussions on ACE carry-off cooling were held. Shortly before this meeting, a decision had been made requiring that the ACE carry-off equipment be purged with gaseous nitrogen or clean air during certain portions of the countdown. With this in mind, a clarification was sought of the various ACE carry-off configurations and their heat loads. The following spacecraft

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(1) "Some Observations on the LEM Mock-up Countdown Demonstration, NAA, Downey, California, March 22-23, 1966 - Case 330". Bellcomm Memorandum for File dated April 12, 1966 by L.G. Miller.

(2) Apollo-Saturn Launch Operations Panel action item number LOP9-11, Meeting No. 9, March 29, 1966.

GSE was covered, starting at the component level and working up to the complete piece of equipment:

1. The "work around" unit, consisting of the C14-202, C14-203 and C14-204, which was used for AS 201 and is scheduled for use with AS 202.

2. The C14-209, which replaces the "work around" unit for AS 204 and AS 205.

3. The C14-207, the uplink to be used for AS-501 and all Block II command modules.

4. The C14-208, the downlink to be used on AS 501 and all Block II command modules.

The information obtained was reviewed at MSC, and a letter stating cooling and purging requirements at each ACE carry-off location was written. A copy of this letter is attached.

Current Status

Upon receipt of the letter referred to above, the Manned Spacecraft Office at KSC brought the requirements to the attention of the Facilities Engineering and Construction Division (EDV-2) and the Launch Support Equipment Engineering Division (EDV-1). It was noted that the LC 34 ORD of June 19, 1966 had to be met. Plans for implementation of the requirements on the remaining launch complexes were also requested.

As of April 20, EDV-183 had made a study indicating that air for cooling and purging the CM ACE carry-off equipment at LC 34 could best be provided by diverting a portion of the air presently being supplied to the CM cabin by the pad ECS. The air duct running across the CM Access Arm would be tapped, probably with a length of flexible duct, and the system would be balanced to provide the proper quantity of air to both the CM cabin and the carry-off ACE. The flexible duct would be removed when the service structure is moved back. Although sufficient air is available from the LC 34 pad ECS, the cooling capacity of the system will have to be increased in order to restore its back-up capability. An off-the-shelf conversion kit is available for this purpose. At this time, there is no indication that the LC 34 ORD will be jeopardized. While this solution only applies to LC 34, there is ample reason to believe that it will also be used on LC 39.

There had been some thought given to using surplus air conditioning units from the Pegasus program as a separate source of air and cooling for the ACE equipment. This idea appears to have been dropped due to certain inherent implementation problems.

As noted in the attached letter, purging and cooling requirements of the LEM ACE carry-off can be met by using a portion of the LEM cabin air supplied by the CCCU. The implementation of this solution does not appear to present any significant difficulties.

2032-LGM-gdn

L. G. Miller

Attachment

Copy to
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Houston, Texas 77058

IN REPLY REFER TO: PD4/L426/66 April 12, 1966

TO : Kennedy Space Center
Attn: H. E. McCoy, Chief, Manned Spacecraft Office
Code PPR-1

FROM : Chief, System Integration Branch

SUBJECT : ACE Carry-off cooling

The MSC has reviewed requirements for CSM and LEM ACE carry-off equipment cooling and purging at the various launch facilities. These requirements are specified below by facility.

A. Pad 34

CM ACE carry-off equipment shall be located on platform 8 of the service structure and is required for checkout and monitoring from T-40 days until T-12 hours. The NAA C14-209 equipment requires 35 #/min of cooling air at 70 + 5°F inlet temperature, 50% maximum relative humidity and 5" $H_2\overline{0}$ pressure. Presently the ACE modules are located on a temporary rack which is not capable of holding a positive pressure. The C14-209 rack will not be available until September 1966. NAA will modify the temporary rack to hold a positive internal pressure (or supply a tent) for AS-202. Subsequent launches from Pad 34 will utilize the C14-209 console. The KSC Safety Office has advised MSC that use of this equipment during hazardous conditions requires a positive internal pressure with clean air, or an inert gas supply. The higher airflow requirements for cooling this equipment have resulted from a better understanding of the heat rejection characteristics and test results indicating the downlink equipments requires operation within a 20°F temperature range to obtain the required signal accuracy. The IRN previously signed by MSC is considered valid.

No LEM ACE carry-off is utilized on Pad 34.

C O P Y

B. Pad 37

LEM ACE carry-off equipment is located in Silo B-1 in four boxes hung under platform 6. These locations provide short cable lengths to the LEM and minimize crowding on platform 5. This equipment is required from T-40 days until T-14 hours for checkout and monitoring. The GAEC LEM ACE requires 20 #/min cooling air at 70 + 5°F inlet temperature, 50% maximum relative humidity and 5" H_2O pressure. The higher than previously stated cooling requirements result from a better understanding of the heat rejection characteristics and a requirement that the downlink equipment operates within a 20°F temperature range to obtain the required signal accuracy. GAEC proposes that this cooling requirement, and the requirement for ACE purging during hazardous periods be met by routing a portion of the LEM environmental room and LEM cabin conditioning air (41 #/min from the CCCU) to the ACE carry-off. 65ICD6200, IRN R-8 and R-2A should be implemented with a change to 20 #/min cooling flow.

CM ACE carry-off is not required on Pad 37.

C. Complex 39 - MSS

CM ACE carry-off units C14-207 and -208 are located on platform 4C of the MSS and are utilized from T-30 days until T-12 hours. These units require a total of 35 #/min cooling air at 70 + 5°F inlet temperature, 50% maximum relative humidity and 5" H_2O pressure. These units are utilized for checkout and monitoring and require clean air or inert gas purge during hazardous conditions.

The four LEM ACE carry-off units are to be hung from the roof of platform 3 and are required for checkout and monitoring from T-30 days until T-14 hours. These locations provide minimum ACE cable lengths and are compatible with existing cables. The four unit concept is required for mounting the units on the LEM for polarity fixture testing in the MSOB. The units require a total of 20 #/min cooling air at 70 + 5°F inlet temperature, 50% maximum relative humidity and 5" H_2O pressure. Clean air or an inert gas is required to provide hazard proofing. This facility requirement could be met by either diverting a portion of the LEM cabin conditioning air from the CCCU, or from a new separate remote air supply for both LEM and CM ACE carry-on cooling and purging.

D. Pad 39 - VAB

CM ACE carry-off units C14-207 and 208 are located on extensible platform A in the VAB and are utilized from T-75 days until T-45 days. These units require 35 #/min cooling air which can be supplied by utilizing the airconditioned air available in the spacecraft work enclosures. The units have built-in fans for circulating cooling air and no purge flow is required.

The four LEM ACE carry-off units are to be suspended from the platform B roof for close proximity to the SLA access ports and to minimize ACE cable lengths. These units can be supplied 20 #/min total cooling air requirements by KSC-supplied cooling fans attached to each unit, circulating conditioned enclosure air. No purge is required.

E. MSOB

CM ACE carry-off units C14-207 and 208 require 35 #/min cooling air which can be supplied by their built-in cooling fans from the airconditioned MSOB invironment.

LEM ACE carry-off units require 20 #/min cooling air which can be supplied by the CCCU cooling unit. No purge is required.

MSC System Integration Branch personnel are available to discuss any questions you may have on the implementation of the above requirements.

Aaron Cohen

C O P Y